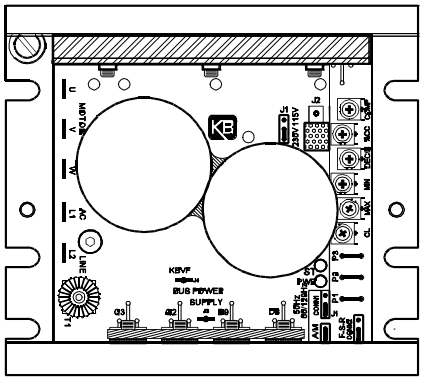
INSTALLATION AND OPERATING INSTRUCTIONS

KBVF

Adjustable Frequency Drive

Variable Speed /Soft-Start AC Motor Control
with I^2t Electronic Overload Protection
for 3-Phase Induction Motors through 1 HP



See Safety Warning on Page 3

This Manual Covers the Following Model Numbers

KBVF-13, 23, 23D, 14, 24 and 24D

The information contained in this manual is intended to be accurate. However, the manufacturer retains the right to make changes in design which may not be included herein.

CE

See Page 4

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A COMPLETE LINE OF MOTOR DRIVES

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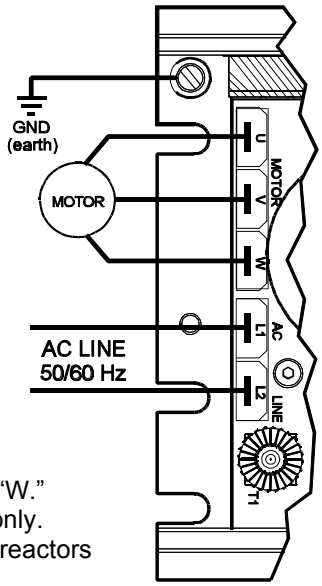
i. SIMPLIFIED SETUP AND OPERATING INSTRUCTIONS

IMPORTANT – You must read these simplified operating instructions before you proceed. These instructions are to be used as a reference only and are not intended to replace the detailed instructions provided herein. You must read the Safety Warning before proceeding.

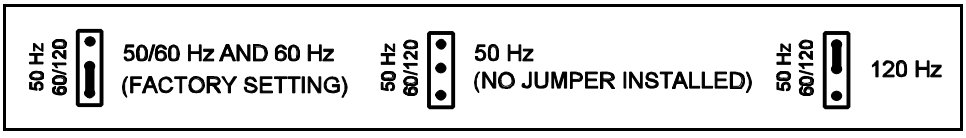
Be sure to read Important Application Information on page 7.



1. **AC POWER.**
   Use 115VAC rated controls on 115VAC and 230VAC rated controls on 230VAC. For dual input voltage controls, be sure the AC line jumpers (J1 and J2 on upper PC board) are both set for the correct AC line voltage 115 or 230VAC. Connect the AC power to terminals L1 and L2. **Be sure the AC power is disconnected when making connections to control. Do not bundle AC power and motor wires with any other wires to control.** When the power is turned on the "PWR" LED will light and the "ST" LED will flash. Connect ground (earth) to green ground screw located on the control chassis.

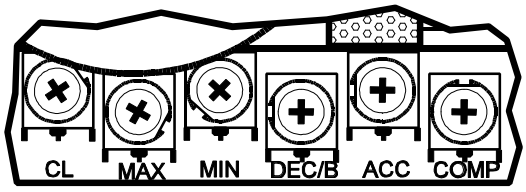
2. **MOTOR LEADS.**
   Connect the three motor leads to terminals "U," "V," and "W." Be sure motor is wired for proper voltage: 208-230VAC only. Motor cable length should not exceed 100 feet – special reactors may be required – consult factory.

3. **MOTOR FREQUENCY SELECTION.**
   Control is factory set for 60 Hz and 50/60 Hz motors. For 50 Hz motors, completely remove jumper J1 on lower PC board. (**Note:** In 50 Hz mode, DECEL trimpot becomes adjustable boost.) For 120 Hz over speed operation, place jumper J1 in the 120 Hz position.



4. **TRIMPOT SETTINGS.**
   The KBVF has been factory set for most applications. For readjustment procedures, see sec. IX, p. 24.

5. **POTENTIOMETER CONNECTIONS.**
   Connect the 5K ohm potentiometer to terminals P1, P2 and P3 as shown in fig. 10A, p. 19.



Notch on trimpot knob indicates position

6. **SIGNAL FOLLOWING.**
   For signal following, an ***isolated*** 0-5VDC must be used.
   Connect signal (POS) to P2 and signal (NEG) to P1 (Note: For signal following, the MIN trimpot must be set to zero - CCW). **Warning! Do not earth ground any input signal wiring.**

7. **FUSING.**
   Install a fuse or circuit breaker in the AC line. Fuse each conductor not at ground potential. See sec. VI, p. 21 for recommended fuse size.

ii. SAFETY WARNING! — PLEASE READ CAREFULLY

This product should be installed and serviced by a qualified technician, electrician or electrical maintenance person familiar with its operation and the hazards involved. Proper installation, which includes wiring, mounting in proper enclosure, fusing or other overcurrent protection and grounding, can reduce the chance of electric shocks, fires or explosion in this product or products used with this product, such as electric motors, switches, coils, solenoids and/or relays. Eye protection must be worn and insulated adjustment tools must be used when working with control under power. This product is constructed of materials (plastics, metals, carbon, silicon, etc.) which may be a potential hazard. Proper shielding, grounding and filtering of this product can reduce the emission of radio frequency interference (RFI) which may adversely affect sensitive electronic equipment. If information is required on this product, contact our factory. It is the responsibility of the equipment manufacturer and individual installer to supply this safety warning to the ultimate user of this product. (SW effective 11/92)

This control contains electronic Start/Stop and Enable circuits that can be used to start and stop the control. However, these circuits are never to be used as safety disconnects since they are not fail-safe. Use only the AC line for this purpose.

The input circuits of this control (potentiometer, start/stop, enable) are not isolated from AC line. **Be sure to follow all instructions carefully. Fire and/or electrocution can result due to improper use of this product.** After disconnecting AC power, high voltage exists on this control until both LED's are extinguished.

CE This product complies with all CE directives pertinent at the time of manufacture. Contact factory for detailed installation instructions and Declaration of Conformity. Installation of a CE approved RFI filter (KBRF-200A, KB P/N 9945A or equivalent) is required. Additional shielded motor cable and/or AC line cables may be required along with a signal isolator (SIVF, KB P/N 9474 or equivalent).

I. GENERAL INFORMATION.

The KBVF Adjustable Frequency Drive is designed to provide variable speed control of standard three-phase AC induction motors. Adjustable linear acceleration and deceleration are provided, making the drive suitable for soft start applications. The output voltage is sinewave coded PWM operating at 16 kHz, which provides high motor torque, high efficiency and low noise. The KBVF is a full featured drive, and due to its user friendly design, it is easy to install and operate. Simple trimpot adjustments eliminate the computer-like programming required on other drives. However, for most applications, no adjustments are necessary.

The KBVF main features include Adjustable RMS Current Limit and I^2t Motor Overload Protection. Adjustable Slip Compensation provides excellent load regulation over a wide speed range. Power Start™ delivers over 200% motor torque to insure startup of high frictional loads. Several models, through 1 HP, are available to control a standard 208-230VAC - 50, 60 and 50/60Hz motor from either a 115 or 230VAC-50/60Hz AC line. The KBVF is easily tailored to specific requirements via selectable jumpers, such as Frequency Range (0-60, 0-50, 0-120Hz), Manual/Auto Restart, and Forward-Stop-Reverse operation. Other standard features include Electronic Inrush Current Limit (EICL™), which eliminates harmful AC line inrush current, and a built-in dV/dT filter, which reduces harmful voltage spikes to the motor. Also, two LED indicator lamps provide the user with diagnostic information. The drive is housed in a versatile U-frame chassis, which facilitates mounting and wiring.

TABLE 1 – GENERAL PERFORMANCE SPECIFICATIONS (All Models)

Parameter	Specification	Factory Setting
Recommended AC Line Input Operating Range (% of nominal 115/230 VAC)	±10	—
Maximum Input Voltage Range, 115 VAC Models (VAC)	97 – 135	—
Maximum Input Voltage Range, 230 VAC Models (VAC)	195 – 270	—
Maximum Load (% Current Overload for 2 Minutes)	150	—
Switching Frequency - at Motor (kHz)	16	—
Signal Following Input Voltage (VDC)*	0 – 5	—
Signal Following Input Resolution (bits)	8	—
Minimum Speed Trimpot Range (% of frequency setting)	0 – 40	0
Output Frequency Setting (Hz)	50, 60, 120	60
Maximum Speed Trimpot Range (% of frequency setting)	70 – 110	100
Speed Range (ratio)	50:1	—

*Isolated Input Signal must be used

General Performance Specifications (Continued)

Parameter	Specification	Factory Setting
Acceleration Trimpot Range (secs)	.3 – 20	1.5
Deceleration Trimpot Range (secs)	.3 – 20	1.5
Boost Trimpot Range (50 Hz only) (%)	6 – 30	—
Slip Compensation Trimpot Range (Volts/Hz/Amp)	0 – 3	1.5
Current Limit Trimpot Range - HP (amps AC)	1.5 – 4.5	3.8
Current Limit Trimpot Range - 1 HP (amps AC)	2.5 – 7.5	6.0
Speed Regulation (0-Full Load 30 to 1 Speed Range) (%Base Speed)	2.5	—
Operating Temperature Range (°C)	0-45	—
Overload Protector Trip Time (Stalled Motor) (Secs)	6	—
Bus Overvoltage Trip Point (VDC) (Equivalent AC Line Volts – 230 VAC Line)	400 (283)	—
Bus Undervoltage Trip Point (VDC) (Equivalent AC Line Volts – 230 VAC Line)	260 (184)	—

TABLE 2 – ELECTRICAL RATINGS

Model No.	KB Part No.	Input Voltage (VAC– 50/60 Hz) Single Phase	Nominal Output Voltage (VAC)	Maximum Horsepower Rating HP, (KW)	Maximum Continuous Output Load Current (RMS Amps/Phase)	Maximum AC Line Input Current (Amps AC)
KBVF-13	9957	115	0 – 230	1/2, (.37)	2.4	11.0
KBVF-23	9958	230	0 – 230	1/2, (.37)	2.4	7.0
KBVF-23D	9959	115/230	0 – 230	1/2, (.37)	2.4	11.0 / 7.0
KBVF-14	9977	115	0 – 230	1, (.75)	4.0	16.0
KBVF-24	9978	230	0 – 230	1, (.75)	4.0	10.0
KBVF-24D	9979	115/230	0 – 230	1, (.75)	4.0	16.0 / 10.0

II. IMPORTANT APPLICATION INFORMATION.

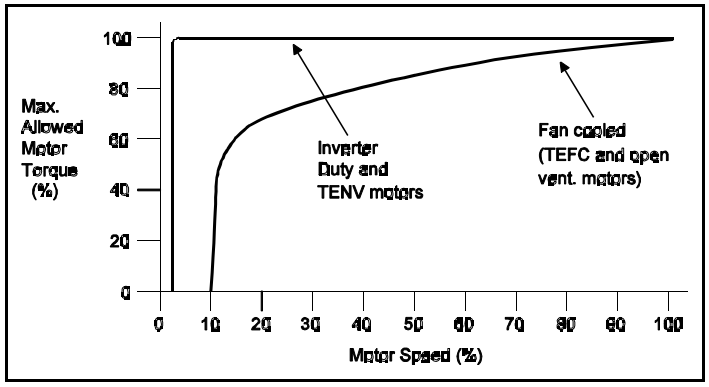
Most fan-cooled (TEFC and open ventilated) 3-phase motors will overheat if used with an inverter beyond a limited speed range at full rated torque. Therefore, it is necessary to reduce motor load as speed is decreased. Note: Some fan cooled motors can be used over a wider speed range. Consult motor manufacturer for details.

⚠ **WARNING!** There may be some motors whose characteristics may cause overheating and winding failure under **light load** or **no load** conditions. If the motor is operated in this manner for an extended period of time, it is recommended that the unloaded motor amperage be checked from 2-15 Hz (60-450 RPM) to ensure motor current does not exceed the nameplate rating. **Do not use the motor if the motor current exceeds the nameplate rating.**

...Continued on page 8

Inverter duty and most totally enclosed nonventilated (TENV) motors can provide full rated motor torque over an extended speed range without overheating see fig. 1.

FIG. 1 – MAXIMUM ALLOWED MOTOR TORQUE vs SPEED



⚠ **Therefore, it is recommended that this control be used with inverter duty and totally enclosed nonventilated (TENV) motors.**

If external fan cooling is provided, open-ventilated motors can also achieve an extended speed range at full rated torque. A box fan or blower with a minimum of 100 CFM is recommended. Mount the fan a few inches from the motor so it is surrounded by the air flow.

FIG. 2 – MOTOR WITH EXTERNAL COOLING

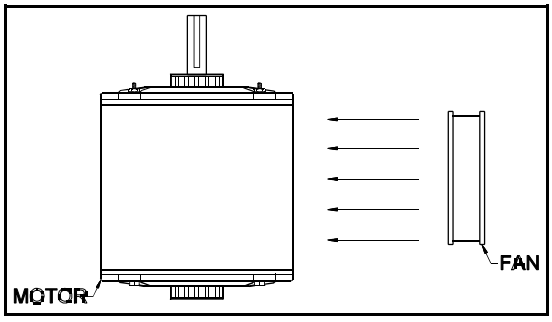


FIG. 3 – CONTROL LAYOUT

Illustrates factory setting of jumpers and approximate setting of trimpots

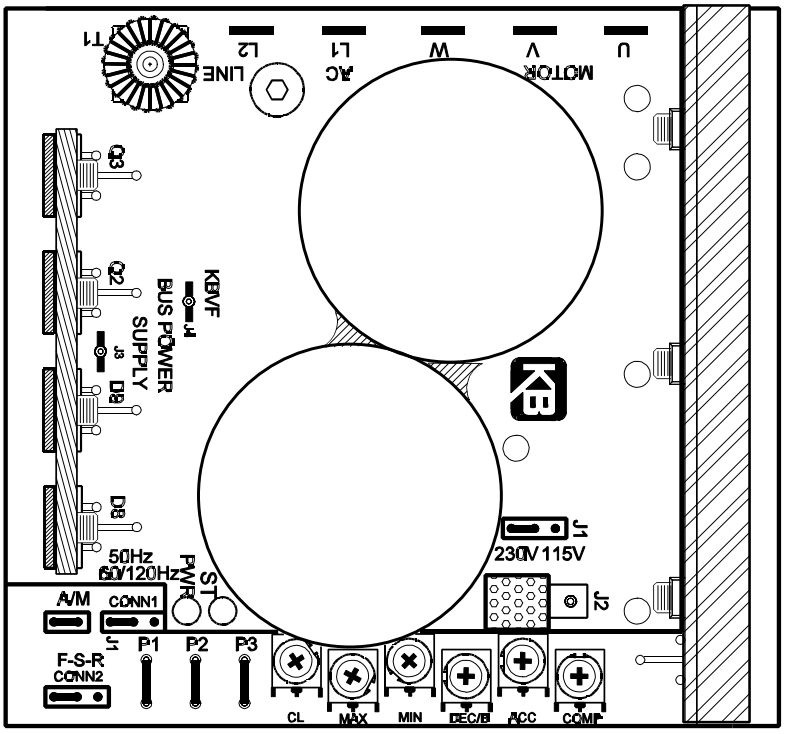


FIG. 4A – KBVF HP MECHANICAL SPECIFICATIONS – INCHES / [mm]

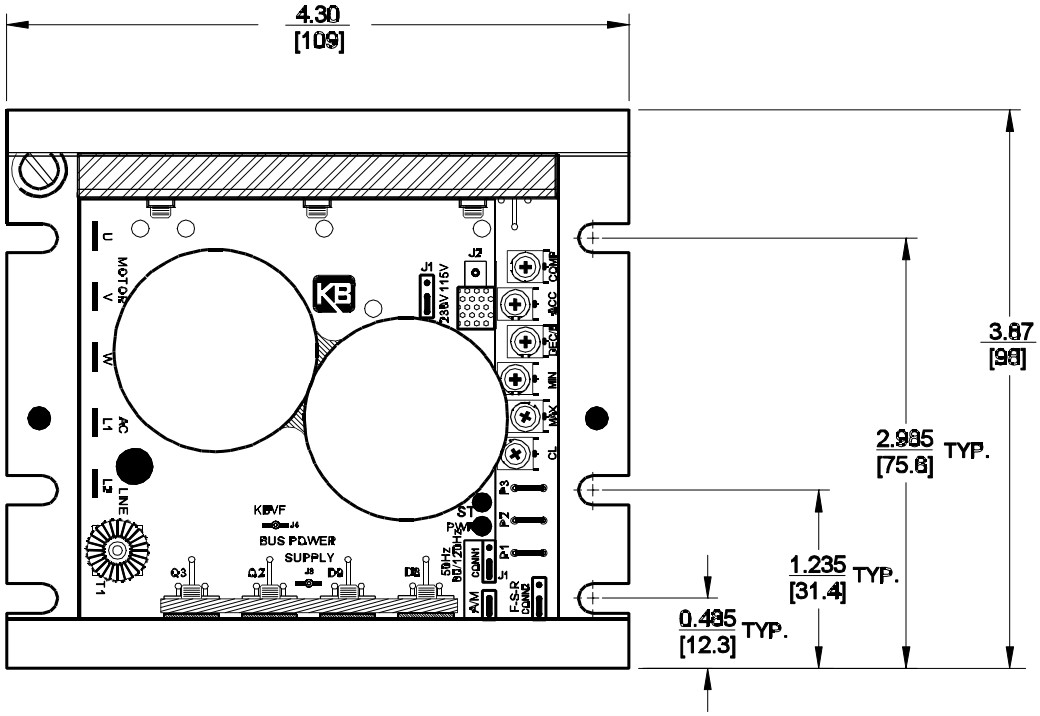
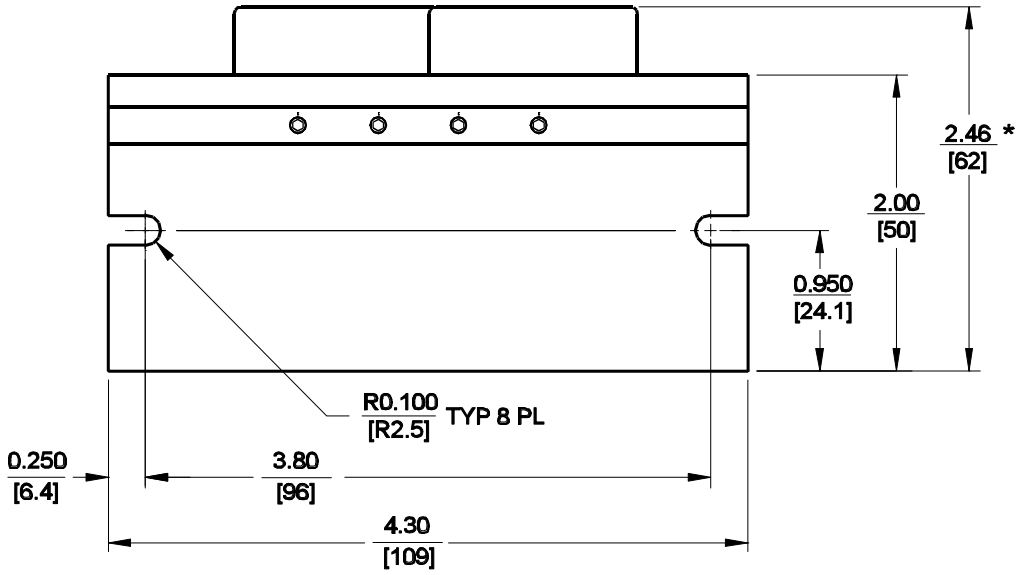


FIG. 4B – KBVF HP MECHANICAL SPECIFICATIONS – INCHES / [mm]



* NOTE: MAXIMUM HEIGHT MAY BE INCREASED TO 2.659/[67.5]

FIG. 5A – KBVF 1 HP MECHANICAL SPECIFICATIONS – INCHES / [mm]

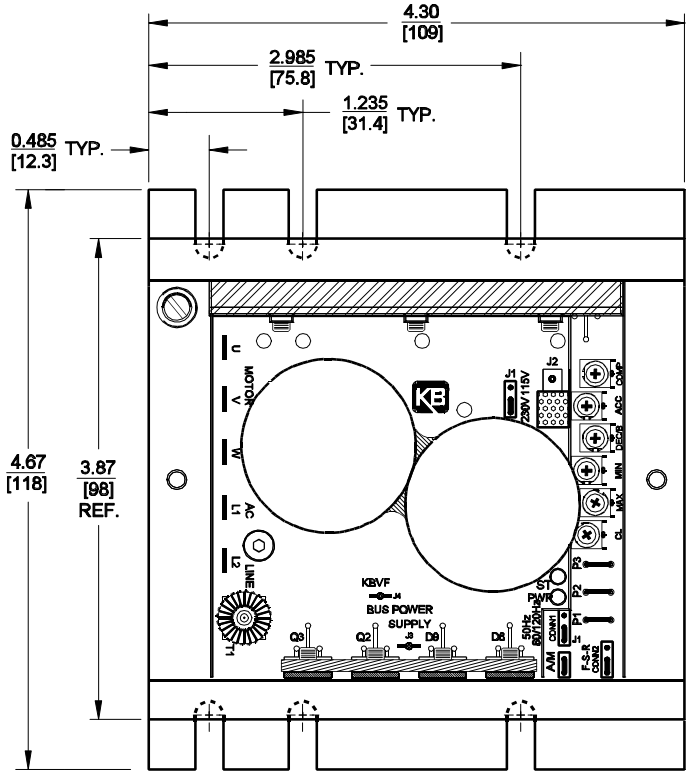
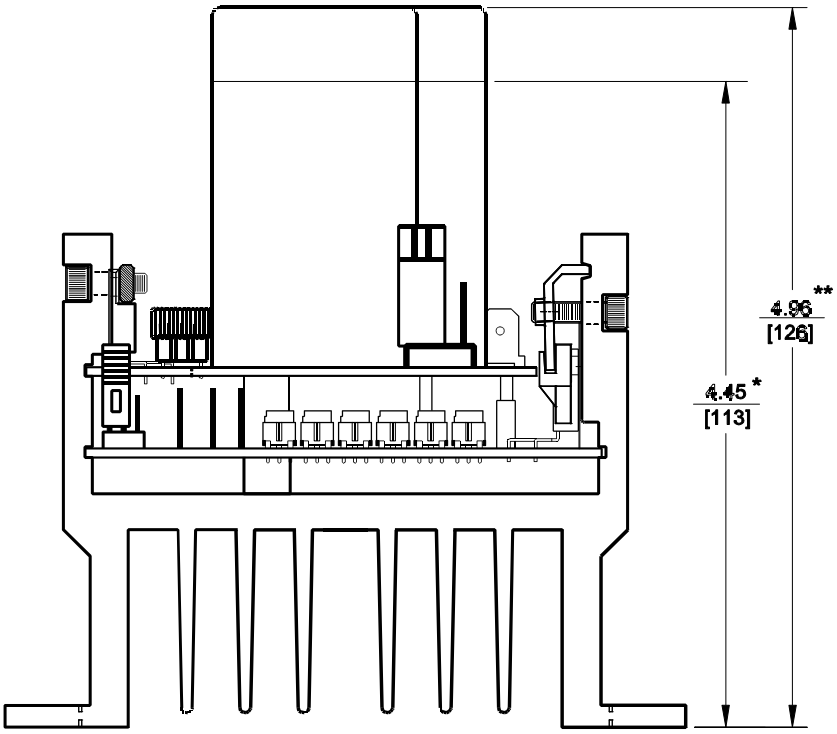


FIG. 5B – KBVF 1 HP MECHANICAL SPECIFICATIONS – INCHES / [mm]



*CONTROL HEIGHT: KBVF-24 / **CONTROL HEIGHT: KBVF-14, 24D

III. JUMPER SETTINGS.

A. **Dual Voltage Controls** – Models KBVF-23D and KBVF-24D have the capability of operating standard 208-230VAC - 50/60 Hz, 3-phase motors from either a 115VAC or 230VAC - 50/60 Hz AC line. The jumpers are factory set for 230VAC - 50/60 Hz. Use jumpers J1 and J2 on the top PC board to change the voltage input.

FIG. 6A – J1 & J2 SET TO 230 VOLTS

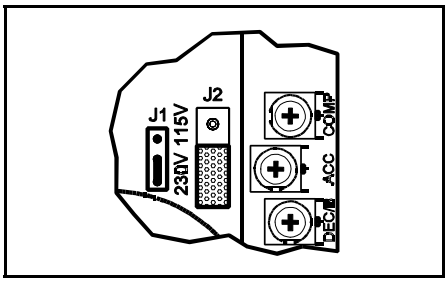
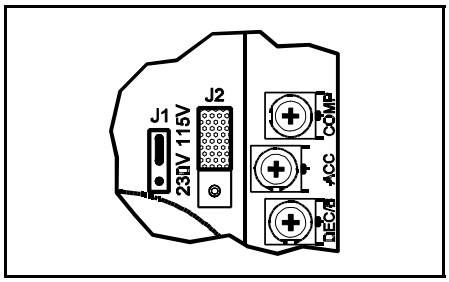


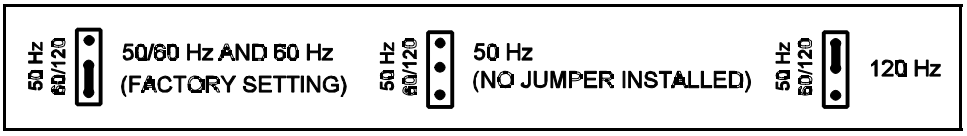
FIG. 6B – J1 & J2 SET TO 115 VOLTS



Warning! Do not change jumper position with AC line connected. Be sure proper input voltage is applied to control corresponding to jumper setting. Connecting 230VAC to a 115VAC control input will permanently damage control. "115VAC" and "230VAC" labels are provided. Use the appropriate label to identify the correct input voltage after setting jumpers.

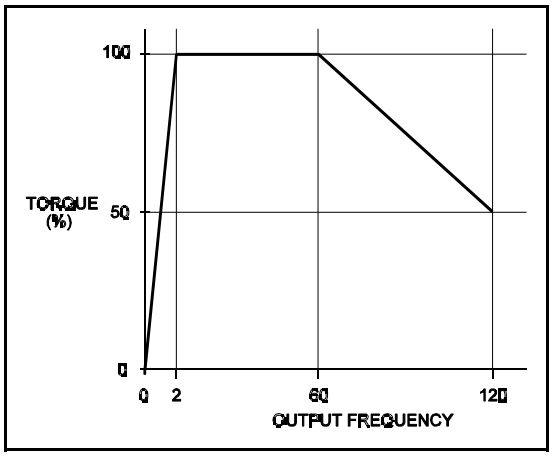
B. **Motor Frequency** – The controls are factory set to operate 60 Hz and 50/60 Hz motors. For 50 Hz motors, completely remove jumper J1 on lower PC board.
Note: When the control is set for 50 Hz operation, the DECEL trimpot will automatically change to adjustable boost. See sec. IX, G, p. 28.

FIG. 7 – JUMPER (J1) OUTPUT FREQUENCY SETTING



The control can also operate 60 Hz and 50/60 Hz motors (not 50 Hz motors) in an over speed mode. Note: In this mode, motor will produce full rated torque up to 60 Hz. Above 60 Hz, torque will linearly reduce to 50% at 120 Hz.

FIG. 8 – AVAILABLE TORQUE vs OUTPUT FREQUENCY



C. **Auto/Manual Operation.**

i. **Auto Operation:** The control is factory set to start automatically each time the AC line is connected. It will also automatically start when recovering from faults due to overvoltage, undervoltage and short circuit. If an I^2t fault occurs due to a prolonged overload, the control must be manually restarted.

Note: The control can be restarted due to an I^2t fault by one of the following methods:

1. Disconnect and reconnect the AC power ("ST" LED must change from flashing green to Red/Yellow flash - approximately 15 seconds.)
2. Turning the main speed pot to zero (MIN speed trimpot must be set to "zero" speed in order to reset with main speed pot).
3. Use Enable contact. See section V, F, on page 20.

Note: If the control trips in I^2t, the motor may be overloaded. Check motor current with an AC ammeter. (Use RMS responding meter.) Also, the CL setting may be set too low (see sec. IX, E, p. 26).

ii. **Manual Operation:** To operate in the manual mode the A/M jumper must be removed and the 2-wire connector (supplied) must be installed. See sec. V, E, p.20. for complete details.

D. **Forward - Reverse** – The controls are factory set for "Forward" operation. If, after wiring the control, it is determined the motor direction is incorrect, simply change the F-S-R jumper position from "F-S" to the "S-R" position.

WARNING! (Be sure to disconnect power and wait for the "PWR" LED to extinguish.)

See sec. V, F, p. 20 for complete details on using the F-S-R function.

Note: Two motor leads can be interchanged to change rotation.

IV. MOUNTING.

Mount the control on a flat surface free of moisture, metal chips, and other contamination, including corrosive atmosphere, that may be harmful. For maximum cooling efficiency, mount the control with fins or sides in a vertical position. If controls are to be mounted in an enclosure, allow at least 6" x 8" x 12" for HP and 8" x 8" x 16" for 1 HP. Also, mount control as close as possible to the bottom of the enclosure. When mounting the 5K remote speed potentiometer, be sure to install insulating disc between potentiometer and inside of front panel.

Warning! Do not use Start/Stop or Enable circuits as an emergency stop or severe injury may result.

Warning! Do not wire control with power on. Electrocution or death may result.

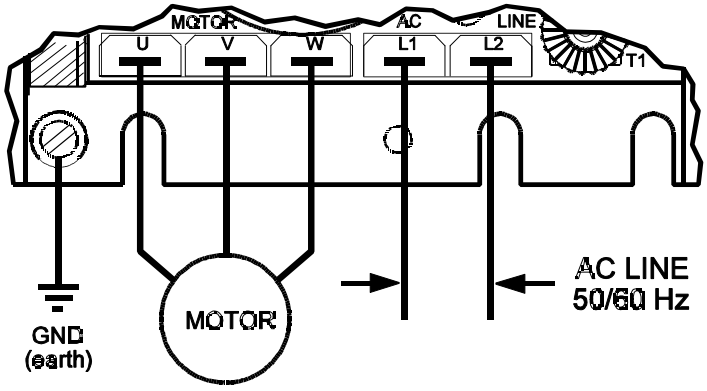
V. WIRING.

(Use the quick connect terminals provided for AC line, motor and speed pot wiring.)

TABLE 3 – TERMINAL WIRING INFORMATION

Terminal Designation	Connection Designation	Type of Connector	Supply Wire Gauge	
			Minimum	Maximum
AC Line	L1, L2	1/4" QD	16	14
Motor	U, V, W	1/4" QD	16	14
Potentiometer	P1, P2, P3	1/4" QD	22	18

FIG. 9 – MOTOR AND AC LINE CONNECTIONS



A. **AC Line** – Wire the correct input AC line voltage 115, 230VAC - 50/60 Hz to terminals L1 and L2, depending on model number and jumper selection for dual voltage models. **Be sure to connect proper input voltage to control - catastrophic control failure can result due to improper voltage.** It is recommended that a fuse be installed on each ungrounded conductor. Do not fuse neutral conductors. Follow NEC or other electrical codes that apply. See sec. VI, page 21 for recommended fuse size.

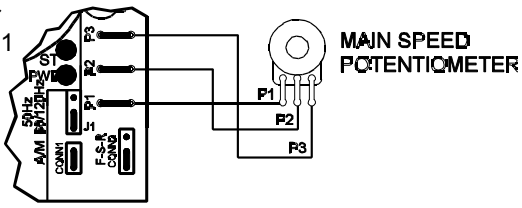
Be sure to ground chassis using green ground screw. **Do not ground (earth) any signal connections.** See fig. 9.

B. **Motor** – Connect motor wires to terminals "U," "V" and "W." It is recommended that the cable length be limited to 100 feet between control and motor. See fig. 9. **Note:** If cable length is greater than 100 feet, special reactors may have to be installed. **Important! These controls are designed for 208 - 230 VAC motors - be sure motor is wired correctly.**

IMPORTANT - Do not bundle low voltage signal wiring (main speed potentiometer, signal following, manual start or forward-stop-reverse/enable) with any main power wiring from AC line or motor. For all signal wiring over 18" shielded cable is recommended. Do not ground (earth) shield.

C. **Speed Potentiometer** – Connect speed potentiometer as shown . The high side is wired to P3 and the wiper is wired to P2. Wire the low side to P1 - **do not ground (earth) low side of potentiometer or catastrophic control failure will result.**

FIG. 10A – Main Speed Potentiometer Connection



D. **Signal Following** - The control may be operated with a 0 - 5VDC ***isolated*** signal in lieu of the main speed potentiometer. Connect pos (+) signal to P2 and neg (–) to P1. **Do not ground neg (–) signal wire.**

FIG. 10B – SIGNAL FOLLOWING 0 – 5VDC (Isolated)

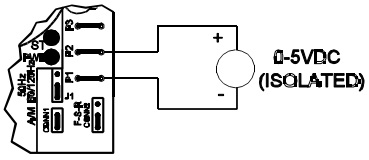
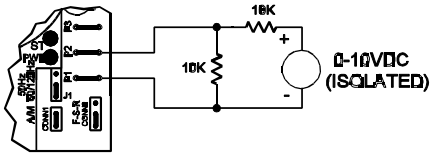


FIG. 10C – SIGNAL FOLLOWING 0 – 10VDC (Isolated)



Note: For proper operation, "MIN" trimpot must be turned to zero (CCW). If 0-10VDC operation is required, a resistor network can be added as per fig. 10C. If an isolated signal is not available, a separate signal isolator must be used (KBSI-240D or equivalent). Do not ground (earth) signal wiring.

E. **Manual Start Mode** - To operate in the manual start mode the A/M jumper must be removed and the 2-wire connector (supplied) must be installed. The connector must be wired to a momentary reset switch or contact. See fig. 11B. In the Manual mode the control will trip due to all faults, overvoltage, undervoltage, short circuit and I^2t and remain tripped even when the fault condition is corrected. (See LED diagnostics, sec. VIII, p. 22.) The control must be reset manually by closing the A/M contacts. Also, the control must be restarted each time the AC line is interrupted.

FIG. 11A – AUTO/MANUAL SELECTION

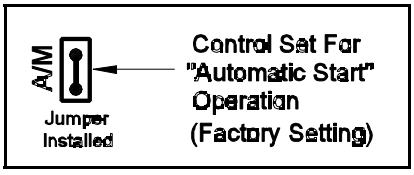
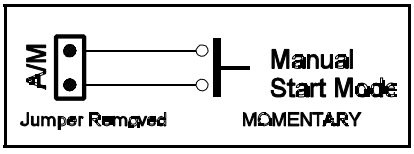
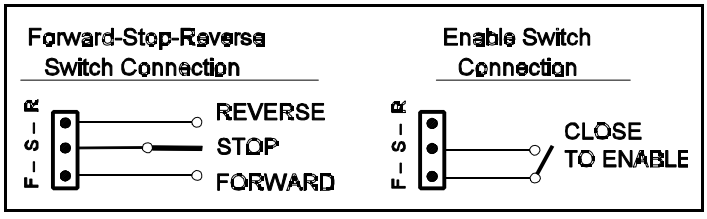


FIG. 11B – MANUAL START SWITCH CONNECTION



F. **Forward-Stop-Reverse/Enable** - The KBVF may be controlled in several ways using the Forward-Stop-Reverse/Enable circuit. Remove the F-S-R jumper and install the 3-wire connector (supplied). The control can now be made to instantly reverse or start/stop electronically (Enable). See fig. 12 for Start/Stop - Enable and Forward-Stop-Reverse connections.

FIG. 12 – FORWARD-STOP-REVERSE/ENABLE



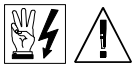
VI. FUSING.

It is recommended that a fuse or circuit breaker be used on each AC line connection not at ground potential. Do not fuse neutral or ground connections. Use a normal or slow blow fuse according to the table below:

TABLE 4 – FUSE SELECTION CHART

Model	AC Line Voltage	Max AC Line Current	AC Line Fuse (Amps)
KBVF-13	115	11.0	15
KBVF-23	230	7.0	10
KBVF-23D	115	11.0	15
	230	7.0	10
KBVF-14	115	16.0	20
KBVF-24	230	10.0	15
KBVF-24D	115	13.0	20
	230	10.0	15

VII. OPERATION.



Warning! Read Safety Warning on page 3 before attempting to operate. Severe injury or death may result.

After all wiring and setup is completed and rechecked, the control can be powered up. The main speed potentiometer should initially be set at the minimum position (CCW) and gradually rotated clockwise to increase motor speed. Check status LED's to verify proper operation. See sec. VIII, p. 22.

TABLE 5 – KBVF STATUS INDICATORS

LED Ref.	Function	State(1)	LED Color
"ST" (Status)	Normal Control Operation	Slow Flash	Green
	CL (current limit)	Steady	Red
	I^2 t	Quick Flash	Red
	Short Circuit	slow Flash	Red
	Undervoltage	Quick Flash	Red/Yellow
	Overvoltage	Slow Flash	Red/Yellow
	Stop	Steady	Yellow
"PWR" (Power)	Bus & Power Supply	Steady	Green

VIII. LED STATUS INDICATORS.

The KBVF adjustable frequency drive contains two LED status indicators. The first LED is a tricolor lamp (ST) that indicates a fault or abnormal condition. The information provided can be used to diagnose an installation problem, such as incorrect input voltage, overload condition and control circuit miswiring. It also provides a "normal" signal that informs the user that all control and micro processor operating parameters are proper. The second LED is a Power On indicator (PWR) that senses the presence of the bus voltage and the operation of the main control logic power supply. The status functions are summarized in table 5.

Controller Status in Auto Mode	Controller Status in Manual Start Mode	LED Color – Recovered Fault (Manual Mode)
Run	Run	—
Run	Run	Green(2)
Trip(4)	Trip(4)	Green(2)
Shutdown(3)	Trip(4)	—
Shutdown(3)	Trip(4)	Red/Yellow/Green(5)
Shutdown(3)	Trip(4)	Red/Yellow/Green(5)
Shutdown(3)	Shutdown(3)	Green(2)
—	—	—

(1) Slow flash: 1 sec. on, 1 sec. off; Quick flash: .25 sec. on, .25 sec. off.

(2) When control recovers from CL or Stop, the Status LED returns to the "normal" flashing green.

(3) Shutdown: Control will "stop" but will resume operation after fault is cleared.

(4) Trip: Control will "stop" and not restart when fault is cleared. See instructions for restart procedure, sec. V, E, p. 20.

(5) If a fault occurs in the manual start mode, such as undervoltage or loss of AC power, the drive will trip. The status "ST" LED will begin to quick flash Red/Yellow. The drive cannot be restarted if the undervoltage condition persists. When the voltage returns to normal, the "ST" LED will begin to flash Red/Yellow - Green. This signifies that there **was** an undervoltage or loss of voltage condition that has been corrected. The control can now be restarted with the manual start contact.

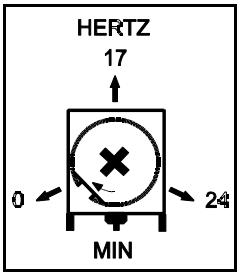
IX. TRIMPOT ADJUSTMENTS

These controls contain trimpots which have been factory adjusted for most applications. Paragraph 4, on page 2, illustrates the location of the trimpots and their approximate adjustment positions. Some applications may require readjustment of the trimpots in order to tailor the control to exact requirements. (See table 1, pages 5 and 6, for range and factory setting of trimpots.) Readjust trimpots as follows:

WARNING! Do <u>not</u> adjust trimpots with main power on if possible. If adjustments are made with power on, insulated adjustment tools must be used and safety glasses must be worn. High voltage exists in this control. Electrocution and/or fire can result if caution is not exercised. Safety Warning on page 3 must be read and understood before proceeding. Failure to follow the Safety Warning Instructions may result in electric shock, fire or explosion.

A. **Minimum Speed (MIN).** The MIN trimpot is used to set the minimum output frequency of the drive, which sets the minimum motor speed. The minimum speed is factory set to zero. Readjust the MIN trimpot as follows:

FIG. 13A – MIN



1. Rotate main speed potentiometer to the minimum speed position (full counterclockwise).

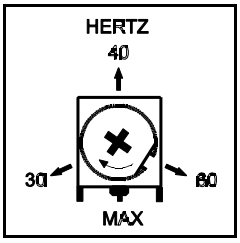
2. Increase setting of MIN trimpot so that motor runs at desired minimum speed.

Note: For signal following operation, the MIN trimpot is not operational and must be set to its minimum position (full counterclockwise).

B. **Maximum Speed (MAX).** The MAX trimpot is used to set the maximum output frequency of the drive. The maximum speed is factory set to full rated motor speed. Readjust the MAX trimpot as follows:

1. Rotate main potentiometer to maximum speed position (full clockwise).
2. Adjust MAX trimpot to desired setting of motor speed.

FIG. 13B – MAX

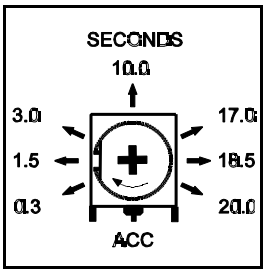


C. **Acceleration (ACC).** The ACC trimpot sets the time it takes the motor to reach full speed from an initial zero start. The trimpot is factory set to approximately 1.5 seconds. Adjust the ACC trimpot as required for the application. See fig. 13C.

Note: When the control is set for 50 Hz operation, the ACC trimpot will automatically change to adjustable acceleration and deceleration.

NOTE: Rapid acceleration may cause the current limit circuit to activate. This will automatically extend the acceleration time.

FIG. 13C – ACC

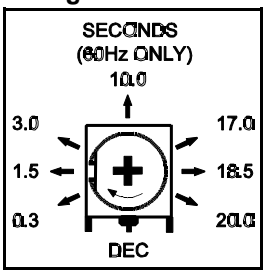


D. **Deceleration (DEC).** The DEC trimpot sets the time it will take the motor to reach zero speed from an initial full speed setting. The trimpot is factory set to approximately 1.5 seconds. Adjust the trimpot as required for application.

Note: When the control is set for 50 Hz operation, the DEC trimpot will automatically change to Adjustable Boost. See sec. IX, G, p. 28.

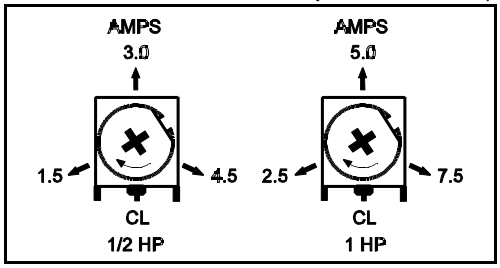
Application Note: On applications with high inertial loads, the deceleration may automatically increase in time. This will slow down the rate of speed decrease to prevent the D.C. bus voltage from rising to the overvoltage trip point. This function is called regeneration protection. **It is recommended that for very high inertial loads that both the ACC and DEC trimpots be set to a minimum of 10 seconds.**

Fig. 13D – DEC



E. **Current Limit with I^2t Shutdown (CL).** The CL trimpot is used to set the maximum motor current that occurs in a stalled condition. The CL trimpot is factory set to approximately 160% of full control rating (3.8 amps: HP, 6.8 amps: 1 HP). The CL trimpot can be readjusted as required. See fig. 13E.

FIG. 13E – CL SETTINGS (HP and 1HP)



The current limit also contains an I^2t trip function. The control will trip according to a predetermined current versus time function. The trip curve is directly related to the CL setpoint and can be changed with the CL trimpot. Table 6, p. 27 relates the CL setpoint to trip time.

The current limit with I^2t shutdown is designed to provide motor overload protection. Readjust the CL trimpot so that it is set to 160% of full rated motor current as follows.

1. Connect an AC ammeter in series with one motor phase.
2. Lock motor shaft and quickly adjust desired locked rotor motor current using CL trimpot.

Note: This adjustment must be made within 6 seconds or I^2t trip will occur.

Example: A HP motor has a full load current of 1.8 amps. Set the CL trimpot to 1.8 x 160% = 2.9 amps.

I^2t trip will now protect the motor against overloads.

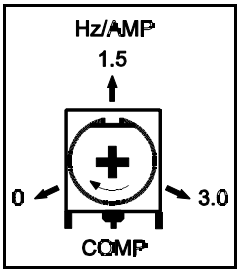
TABLE 6 – CL SETPOINT vs TRIP TIME

Percent of CL Setpoint	Trip Time (Minutes)	Control Rating (%)	Motor Current (Amps/Phase)
100	.1 (6 sec)	160	3.8
88	.8	140	3.4
75	30	120	2.9
63	∞	100	2.4

F. **Slip Compensation (COMP) –** The COMP trimpot is used to maintain set motor speed under varying loads. The factory COMP trimpot setting of 1.5 volts/Hz/amp provides excellent speed regulation for most motors. The COMP trimpot can be adjusted for specific applications as required.

1. Wire an AC ammeter in series with one motor phase.

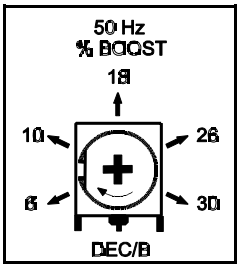
FIG. 13F – COMP



2. Run motor and set unloaded speed to approximately 50% speed (900 RPM on 4-pole 1500/1725 RPM motors). Using a tachometer, record unloaded speed.
3. Load motor to rated motor nameplate current (AC amps).
4. Adjust COMP trimpot so that loaded RPM is equal to unloaded RPM.
5. Motor is now compensated to provide constant speed under varying loads.

G. **Boost** (When the control is set for 50 Hz motors, the Decel trimpot becomes Adjustable Boost.) Most 60 Hz motors conforming to NEMA standards can operate from a preset volts-per-hertz curve. 50 Hz motors generally differ widely in their characteristics. Therefore, it is necessary to have Adjustable Boost to obtain maximum motor performance.

FIG. 13G – DEC/B



Since the boost trimpot was the DEC trimpot in the 60 Hz mode, it will take on the prior setting of the DEC trimpot. In the boost mode the trimpot scale is shown in fig. 13G.

In order for the 50 Hz motor to run properly, the boost must be adjusted. If the application does not require full torque below 10 Hz, the boost trimpot can be conservatively set at 8% (9 o'clock position).

If more precise speed regulation is required due to varying load, the boost can be set as follows:

1. Place an AC analog RMS ammeter in series with one motor lead. (Generally, digital or clamp-on meters do not yield accurate readings.
2. Run the motor **unloaded*** at approximately 4 Hz (or 120 RPM).

   ***Note:** An unloaded motor with excessive boost will draw more current than a partially loaded motor.
3. Turn up boost until the ammeter reaches the nameplate motor rating.
4. Using the main speed potentiometer, slowly adjust motor speed over a 0 – 15 Hz (0 – 450 RPM) range. If motor current exceeds nameplate rating, lower boost setting.

WARNING! TO AVOID MOTOR WINDING OVERHEATING AND FAILURE, DO NOT OVER BOOST MOTOR.

X – LIMITED WARRANTY

For a period of 18 months from date of original purchase, KB will repair or replace without charge devices which our examination proves to be defective in material or workmanship. This warranty is valid if the unit has not been tampered with by unauthorized persons, misused, abused, or improperly installed and has been used in accordance with the instructions and/or ratings supplied. The foregoing is in lieu of any other warranty or guarantee, expressed or implied, and we are not responsible for any expense, including installation and removal, inconvenience, or consequential damage, including injury to any person, caused by items of our manufacture or sale. Some states do not allow certain exclusions or limitations found in this warranty so that they may not apply to you. In any event, KB's total liability, under all circumstances, shall not exceed the full purchase price of this unit. (rev 4/88)

Note: DO NOT REPAIR – This control must be returned to a certified factory repair center.

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